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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/641,768	08/14/2003	Peter A. Burke	03-006/LSI1P219	2802
24319	7590	03/16/2005	EXAMINER	
LSI LOGIC CORPORATION 1621 BARBER LANE MS: D-106 MILPITAS, CA 95035			WILSON, CHRISTIAN D	
			ART UNIT	PAPER NUMBER
			2829	

DATE MAILED: 03/16/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

10/641,768

Applicant(s)

BURKE ET AL.

Examiner

Christian Wilson

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 04 February 2005.
- 2a) ☐ This action is FINAL. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-21 is/are pending in the application.
- 4a) Of the above claim(s) 18-21 is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-4 and 7-17 is/are rejected.
- 7) ☒ Claim(s) 5 and 6 is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 14 August 2003 is/are: a) ☐ accepted or b) ☒ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
 2. ☐ Certified copies of the priority documents have been received in Application No. _____.
 3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|--|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152) |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)
Paper No(s)/Mail Date _____ | 6) <input checked="" type="checkbox"/> Other: <u>search history</u> . |

DETAILED ACTION

Election/Restrictions

1. Applicant's election with traverse of claims 1 – 17 in the reply filed on February 4, 2005 is acknowledged. The traversal is on the grounds that there is no burden on the examiner. This is not found persuasive because, as described in the preceeding restriction, the two groups are distinct since the method of group I can be used to form a materially different product than that of group II, and they have acquired a separate status in the art as indicated by their different classification.

The requirement is still deemed proper and is therefore made FINAL.

2. Claims 18 – 21 are withdrawn from further consideration pursuant to 37 CFR 1.142(b), as being drawn to a nonelected invention, there being no allowable generic or linking claim. Applicant timely traversed the restriction (election) requirement in the reply filed on February 4, 2005.

Information Disclosure Statement

3. The listing of references in the specification, as done on page 20 of the specification, is not a proper information disclosure statement. 37 CFR 1.98(b) requires a list of all patents, publications, or other information submitted for consideration by the Office, and MPEP § 609 A(1) states, "the list may not be incorporated into the specification but must be submitted in a separate paper." Therefore, unless the references have been cited by the examiner on form PTO-892, they have not been considered.

Drawings

4. The drawings are objected to because they contain hand drawn figures and labels.

Corrected drawing sheets in compliance with 37 CFR 1.121(d) are required in reply to the Office action to avoid abandonment of the application. Any amended replacement drawing sheet should include all of the figures appearing on the immediate prior version of the sheet, even if only one figure is being amended. The figure or figure number of an amended drawing should not be labeled as "amended." If a drawing figure is to be canceled, the appropriate figure must be removed from the replacement sheet, and where necessary, the remaining figures must be renumbered and appropriate changes made to the brief description of the several views of the drawings for consistency. Additional replacement sheets may be necessary to show the renumbering of the remaining figures. Each drawing sheet submitted after the filing date of an application must be labeled in the top margin as either "Replacement Sheet" or "New Sheet" pursuant to 37 CFR 1.121(d). If the changes are not accepted by the examiner, the applicant will be notified and informed of any required corrective action in the next Office action. The objection to the drawings will not be held in abeyance.

Claim Rejections - 35 USC § 102

5. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

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6. Claims 1 – 7 and 12 – 17 are rejected under 35 U.S.C. 102(b) as being anticipated by Xi *et al.*

Xi *et al.* (US 2002/0060363) discloses a method of forming a damascene interconnect structure comprising forming a trench **202** in a first dielectric layer **204** on a substrate, forming a dielectric diffusion barrier film **208** in the trench for preventing the diffusion of a copper interconnect metal layer into the dielectric layer [0007], etching the dielectric diffusion barrier film anisotropically to remove the dielectric barrier film from the bottom surface of the trench to expose patterned metal **206** [Figure 4], depositing a barrier metal film **220** in the trench to cover a portion of the bottom surface, and filling the trench with a copper interconnect metal layer [0023].

Regarding claim 2, Xi *et al.* further discloses forming a via **200** aligned with the trench before forming a dielectric diffusion barrier film and forming the dielectric diffusion barrier film in the trench simultaneously with the formation of the film in the via [Figure 3].

Regarding claim 3, Xi *et al.* further discloses where the dielectric copper diffusion barrier layer is formed by CVD [0019].

Regarding claim 4, Xi *et al.* further discloses a barrier metal film covering the sides of the trench [Figure 3].

Regarding claim 7 – 9, Xi *et al.* further discloses a barrier metal film with a thickness of the barrier metal film which is 20 – 50 Å thick [0022] and a dielectric diffusion barrier film which is 50 – 100 Å thick [0041].

Regarding claim 10, Xi *et al.* further discloses depositing a copper seed layer **222** on the barrier metal layer.

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Regarding claim 12, *Xi et al.* further discloses continuously lining the trench with the dielectric diffusion barrier film [Figure 3].

Regarding claim 13, *Xi et al.* further discloses SiN, SiC, and AlN as a barrier material [0018].

Regarding claim 14, *Xi et al.* further discloses forming the dielectric diffusion barrier film by surface treating the dielectric layer using high density plasma bombardment to direct Ar or H₂ particles to the dielectric layer [0030].

Regarding claim 15, *Xi et al.* further discloses anisotropic etching by a plasma etch [0019].

Regarding claim 16 and 17, *Xi et al.* further discloses depositing the barrier metal by a directional deposition such as PVD [0021].

Claim Rejections - 35 USC § 103

7. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

8. Claim 11 is rejected under 35 U.S.C. 103(a) as being unpatentable over *Xi et al.* in view of *Wu et al.*

Xi et al. teaches the limitations of claim 10 as described above, but does not discuss an adhesion promoter layer. *Wu et al.* (US 2004/0130035) teaches an adhesion promoter layer in a damascene structure [0022]. It would have been obvious to one of ordinary skill in the art

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to use the adhesion promoter layer of Wu *et al.* in the method of Xi *et al.* since this layer improves the adhesion between the copper metal layer and the barrier metal layer.

Allowable Subject Matter

9. Claims 5 and 6 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

10. The following is a statement of reasons for the indication of allowable subject matter: applicant discloses a novel method of forming a damascene structure where the thickness of the barrier metal film formed on the sides of the trench is approximately 20% or less or 10% or less than the thickness of the barrier metal film formed on the bottom of the trench.

Conclusion

11. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure. The cited prior art teaches methods of depositing barrier layers in damascene structures.

12. A copy of the search history (EAST and STN) is enclosed.

13. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Christian Wilson whose telephone number is (571) 272-1886.

The examiner can normally be reached on weekdays, 7:30 AM to 4 PM.

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If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Bill Baumeister can be reached on (571) 272-1722. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

A handwritten signature in black ink, appearing to read 'C. Wilson', with a stylized, looping flourish at the end.

Christian Wilson, Ph.D.
Primary Examiner
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CDW